

Long Cadence Cepheid targets – K2 Campaign 0

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Cepheids are large-amplitude pulsating stars and important cosmic distance indicators. They are young supergiants and therefore relatively rare objects in the Galaxy. So rare, in fact, that only a single Cepheid was found in the original Kepler field. V1154 Cyg (KIC 7548061) turned out to be a very well-behaving star with no signs of binarity or low-amplitude additional modes [1,2]. Still, Kepler was able to provide important new insights into this star, revealing that its pulsation experiences cycle-to-cycle fluctuations. The origins of these fluctuations are so far unclear but their detection requires continuous, high-precision photometry. Observing further Cepheids and their siblings with Kepler is therefore very important in understanding the nature and occurrence of this phenomenon.

Aims The observations of Cepheid stars in the K2 mission may provide an opportunity to investigate the following questions.

- Many of the targets are overtone pulsators. In the OGLE LMC data nonradial modes have been detected in many Cepheids, but only in those pulsating in the first overtone [3]. Kepler may provide a great opportunity to compare this result with Galactic Cepheids.

- First overtone Cepheids are more likely to turn out to be double mode (radial) pulsators. If there are unknown double-mode stars in the field their period ratios provide strong constraints on their structure and metallicity.

- Mode interactions create various dynamical phenomena, e.g., period doubling in RR Lyrae stars. Continuous observations may reveal similar effects in Cepheids too.

- A possible anomalous Cepheid (DT Gem) and several W Virginis (population II Cepheid) candidates are located in the field: none of these types of stars have been observed before by space photometric missions.

- Are fluctuations present in all Cepheids? Do overtone pulsators experience stronger fluctuations than fundamental-mode stars?

- Some overtone stars (e.g. DX Gem) show strong O-C variations. Do these variations manifest in the amplitudes as well?

Targets We propose 54 targets for LC observations, half of which are already confirmed as Cepheids. There are 8 stars in total with peak brightness above 10 magnitudes. The brightest star in the field is Zeta Gem with a peak magnitude of 3.75 in V. Such bright star is close to the upper limit of Kepler and might require a custom aperture. However, observing bright targets will allow for extensive spectroscopic and photometric follow-up that may help to characterize the low-amplitude additional modes and the nature of the fluctuations. 10 stars are marked as potential W Virginis-type (population II Cepheid) stars. Compared to the single Cepheid observed in the initial field, these stars can open up yet another field for the K2 mission to revolutionize.

References:

- [1] Derezas et al., 2012, MNRAS, 425, 1312
- [2] Szabó et al., 2011, MNRAS, 413, 2709
- [3] Moskalik & Kołaczowski, MNRAS, 2009, 394, 1649